TOPIC 1

TIME THEORY

The development of high-speed transportation and communications has reduced the relative size of the earth to the extent that people can now travel from North America to Europe in less than 3 hours; a message can be sent from any place on the earth and arrive at any other place in seconds; and weapons of every description can be deployed from subsurface, surface, air, and space platforms. As this technology was emerging, it became apparent that nations could no longer think in terms of local times and conditions. A standard time reference covering the entire world was needed. Without a standard time system, a routine airline flight plan for a Paris-to-San Francisco flight might read like this:

Depart Paris—1200 Local Time
Arrive London—1130 Greenwich Mean Time
Depart London—1200 Greenwich Mean Time
Arrive New York—0950 Eastern Standard Time
Depart New York—1050 Eastern Standard Time
Arrive Denver—0930 Mountain Standard Time
Depart Denver—1000 Mountain Standard Time
Arrive San Francisco—0930 Pacific Standard Time

In computing the elapsed time for the flight, or for any part of it, individual calculations are necessary to adjust for time zone changes. There also might be changes for daylight saving time (DST) or other local differences. Time computations are easier if all times are computed on a common worldwide basis. Then, our flight plan is simplified, looking like this:

Depart Paris—1100 Greenwich Mean Time
Arrive London—1130 Greenwich Mean Time
Depart London—1200 Greenwich Mean Time
Arrive New York—1450 Greenwich Mean Time
Depart New York—l550 Greenwich Mean Time
Arrive Denver—1630 Greenwich Mean Time
Depart Denver—1700 Greenwich Mean Time
Arrive San Francisco—1730 Greenwich Mean Time

GREENWICH MEAN TIME (GMT)

To meet the need for standardization, the international GMT system was developed. All countries of the world adopted its use.

GLOBAL DIVISION AND DESIGNATORS

To compute time differences, you need to understand the international GMT system. In

this system, the surface of the earth is divided into 24 zones, each extending through 15° of longitude, with the initial zone lying between longitudes 7½° east and 7½° west of the prime meridian. (*Longitude* is the name given to the imaginary lines that run lengthwise, north and south, between the North and South Poles. They have east and west designators.) The time system is named after Greenwich, England, because the zero meridian passes directly through that town. Each zone represents a different time in the 24-hour-day cycle, with a 1-hour variation between each time zone. To further aid in zone referencing, each time zone has a numerical, a literal (letter) and, to aid in the mathematical computation, a "+" or a "-" designator.

Numerical Designators

The zero meridian *(prime meridian)* is the imaginary line running down the center of the initial time zone; thus, this time zone is designated "0" (zero) in the numbering system. The remaining zones are numbered consecutively, 1 through 12, both east and west of 7½° longitude, through 180° longitude. The longitudes of 180° east and 180° west are the same imaginary line. This meridian is the *International Date Line.*

Let's pause to consider what appears to be a contradiction. We stated that the earth is divided into 24 time zones; however, we have accounted for 25 zones (12 east of zone 0, 12 west of zone 0, and zone 0 itself, a total of 25 zones). This contradiction will be resolved later in the discussion of the International Date Line and the requirement to have a point at which we shift from one day to another. For now, let's agree there are only 24 time zones.

Literal (Letter) Designators

In addition to all zones having an assigned number, each zone also has a letter designator. The initial time zone, again because of its division by the zero meridian, is designated zone "Z" or ZULU. (Use the phonetic alphabet to pronounce the letters of the time zones.)

With 25 designators, we use every letter of the English alphabet except "J." See figure 1-1. Like the numbering system, the letters begin with the ZULU (0) time zone and progress to the east and west, consecutively. The zones to the east of ZULU are lettered "A" through "M" (ALFA through MIKE) and the zones to the west of ZULU are lettered "N" through "Y" (NOVEMBER through YANKEE). Remember, beginning at ZULU and reading from left to right, we have zones ALFA through MIKE (eastern hemisphere). Returning to ZULU and reading from right to left, we find zones NOVEMBER through YANKEE (westem hemisphere). Don't forget to omit "J" in the eastern hemisphere.

Designators "+" and "-"

Each zone has a designation of either "+" or "-" in addition to the numerical and literal designators. In time-conversion computations, you will see the reason for these designators.

Learning the "+" and "-" designation system is easy. All zones of the western hemisphere have the designation "+." All zones of the eastern hemisphere have the designation "-". see figure 1-1.

PHYSICAL CHARACTERISTICS OF TIME ZONES

With the exceptions of zones MIKE and YANKEE, which we will discuss later, each time zone spans 15° of longitude, with the 24 principal meridians bisecting (dividing in half) each zone. At the equator, each degree of longitude spans 60 nautical miles (NMs). Thus, a time zone spans 900 NMs ($15 \times 60 = 900$).

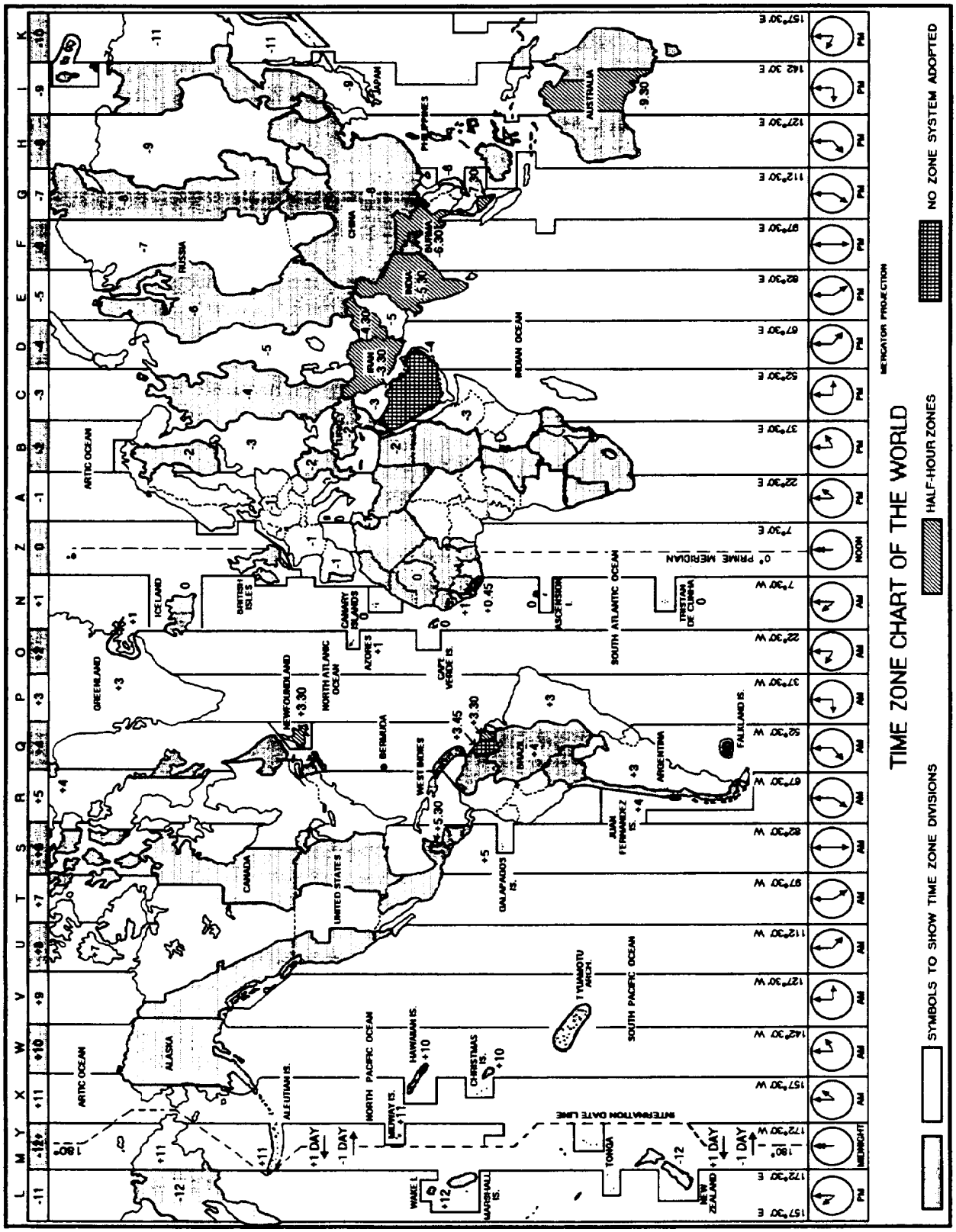

Figure 1-1.—Time zone chart of the world.

NOTE: Remember, only at the equator is each degree of longitude equal to 60 NMs. The natural curvature of the earth causes a narrowing of the zones as the north or south latitude increases. The length of a degree of longitude gets progressively smaller the farther it is from the equator.

Time zones generally correspond with the principal meridians; however, sometimes they deviate from their geographical meridians, especially on land areas. This is common along coastlines, in mountain ranges, and along country borders. These deviations keep time constant wherever possible throughout countries, states, cities, and island chains. See figure 1-1.

EXPRESSION OF TIME

The U.S. military services, as well as most foreign countries, use the international 24-hour system for expressing time. This method uses a four-digit group, with the first two digits denoting the hour, and the second two digits indicating the minutes. Thus, 6:30 A.M. becomes 0630; noon becomes 1200; 6:30 P.M. becomes 1830. Midnight is expressed as 0000, never as 2400. One (1) minute past midnight is 0001. The time designation 1327Z shows that it is 27 minutes past 1:00 P.M., GMT.

To express the day of the month along with the time, we use a six-digit group. These six digits are nothing more than a four-digit time, preceded by two digits indicating the date. This six-digit group is a *date-time group* (DTG). The DTG 171327Z indicates the 17th day of the month at 1327Z.

The date element of the DTG always has two digits. This means the dates from the 1st through the 9th of the month must be preceded by a zero (0) to meet this requirement (for example, 011327Z, 021327Z, or 031327Z). Should a month other than the current one be intended, the standard abbreviation for the month desired follows the DTG (for example, 011327Z JAN, 121327Z FEB, or 211327Z MAR).

In each of the above examples, the times were expressed in ZULU time. This is to make you think in terms of ZULU, since ZULU zone time is the standard time for military communications . All messages, reports, and letters containing times, use ZULU time. This enables all mobile platforms and shore stations to know at what time the subject of the correspondence occurred. It becomes simply a matter of converting the ZULU time of the occurrence to the local time.

Obviously, there are occasions when time must be expressed as local. In these instances, the literal designator for the local zone is used in exactly the same manner as the ZULU designator was used. For example, in the UNIFORM time zone, 171327U would indicate the 17th day of the current month, 27 minutes past 1300 local time.

INTERNATIONAL DATE LINE

The International Date Line divides the eastern and western hemispheres. It is an imaginary line located exactly 180° east longitude and 180° west longitude of the prime meridian. At this point, we must understand the special circumstances surrounding zones MIKE and YANKEE.

Each time zone has a numerical, a literal, and a "+" or a "-" designator, and zones MIKE and YANKEE are not exceptions. There is, however, a very important difference between zones MIKE and YANKEE and all other time zones. To understand this difference, look at zones MIKE and YANKEE as a *single* time zone of 15° of longitude, half (7½°) in the eastern hemisphere, and half in the western hemisphere. Although the two halves of this zone share a common number (12) each half has its own literal and "+" or "-" designator. The eastern hemisphere's half is designated MIKE -12; the western hemisphere's half is YANKEE + 12.

Now we come to a very important point in our discussion. Since we are considering the MIKE and YANKEE zones to be a single zone, it follows that the time in MIKE is *always* the same as that in YANKEE. This is where the International Date Line comes into play, for whenever this line is crossed, whether from east to west or from west to east, the *day must change.* Since we have already established that there is a 1-hour difference between each of the 24 time zones, it is clear that there is always a situation where it is a day earlier or later in one part of the world than it is in another.

RULE: IT IS ALWAYS THE SAME TIME IN ZONE MIKE AS IT IS IN ZONE YANKEE, BUT IT IS *NEVER* THE SAME DAY.

A final point of discussion involving the International Date Line and zones MIKE and YANKEE is the "gaining" or "losing" of a day as the line is crossed. This is not a problem. "Gaining" or "losing" is nothing more than a question of semantics and should not be used in time conversion conversation.

The formula for determining whether to add or subtract one day from the current day at the time of departing one hemisphere for another is:

When you cross the International Date Line, apply the sign of the departed hemisphere. For example, to go from the MIKE zone into the YANKEE zone, subtract one day. MIKE is in the eastern (or the "-") hemisphere. To go from the YANKEE zone into the MIKE zone, add one day. YANKEE is in the western (or the "+") hemisphere. From "-" to "+," subtract; from "+" to "-," add. Another method is simply to remember to add a day when crossing the line westbound and subtract a day when crossing eastbound.

ZONE-TO-ZONE PROGRESSION

At this point, we will discuss one more area needed for time calculation. It is directional flow and the addition or subtraction of an hour when progressing from one time zone into another. Probably the best way to remember whether to add or to subtract the hour is to take the case of the four time zones spanned by the United States (ROMEO through UNIFORM).

Most of us have, at some time or other, watched a sporting event being played on the West Coast while we were physically located on the East Coast. In cases where the contest was held in the late afternoon or early evening in California, it was frequently dark in New York. Obviously, it was earlier in the day in California than it was in New York. Therefore, we can say with confidence that whenever traveling from a westerly direction toward a point eastward, we must add an hour each time we pass from one time zone into another. The opposite is also certainly true. When traveling from an easterly direction toward a point westward, we must subtract an hour for each new zone entered. This rule will hold true regardless of your location in the world: west to east—add, east to west—subtract. Additionally, when the 0000 hour is reached, the day changes accordingly.

TOPIC SUMMARY

It is *absolutely essential* that you understand each of the points covered thus far in this manual before attempting to convert time. The following is a short review of these principles. Test yourself. If you do not fully understand any of them, go back and reread the related section.

1. The international Greenwich mean time (GMT) system was named for the town of Greenwich, England, as the town is located directly on the prime meridian, the point of reference for the entire system.

2. The surface of the earth is divided into 24 time zones, each spanning 15° of longitude.

3. The initial zone is zone 0 (ZULU) and spans the area 7½° longitude east and 7½° longitude west of the prime meridian (a total of 15°).

4. Each zone differs in time by 1 hour.

5. Each zone has a numerical, a literal, and a "+" or a "-" designator (exception: ZULU zone (0) does not have a "+" or "-" designator).

6. The zones are numbered 1 through 12, outwardly from zone 0, throughout both the eastern and western hemispheres.

7. The zones east of ZULU are lettered ALFA through MIKE, omitting JULIETT, and each has a "-" designator.

8. The zones west of ZULU are lettered NOVEMBER through YANKEE, and each has a "+" designator.

9. At the equator there are 60 nautical miles (NMs) in a degree and each time zone spans 900 NMs; a time zone spans 15° of longitude (exception: MIKE and YANKEE—each span 7½° of longitude).

10. The U.S. Navy uses the international 24-hour time system, expressed in four digits; DTGs are formed by preceding the four-digit time with a two-digit number expressing the day.

11. The International Date Line separates the designators MIKE and YANKEE (-12 and +12). The date will always change when crossing this line, regardless of the direction of crossing. When you cross the line, apply the sign of the departed hemisphere.

12. MIKE and YANKEE are one time zone of 15° longitude, sharing the same numerical designator (12). MIKE is the eastern 7½° of longitude of this zone; YANKEE is the western 7½° of longitude.

13. The time will change by 1 hour whenever a new time zone is entered: east to west, subtract 1 hour; west to east, add 1 hour.

14. The day changes to the next or previous day once 0000 is reached, depending upon the direction of travel.

15. The time is always the same in MIKE as it is in YANKEE, but it is *never* the same day.

REFERENCES

Communications Instructions General, ACP 121(F), Annex A, Joint Chiefs of Staff, Washington, DC, 15 April 1983.